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General Guidance On Choice Of Spread Anchors

Introduction

The Spread Anchor System has been used successfully worldwide by companies to handle precast concrete units of various weights and dimensions for over 30 years. This manual has been produced to allow the user to calculate specific Spread Anchor requirements.

Advantages

The Spread Anchor System has a “no fuss” engage and release mechanism on the Spread Anchor Ring Clutch, allowing precast concrete units to be handled quickly and economically, especially when repeated operations are required. The unique lever operated locking mechanism of the system prevents any possibility of accidental release of the concrete unit, whilst also giving a clear visual indication of correct engagement. The Spread Anchor system avoids the need to utilise threaded socket systems with wire ropes and the relative precautions associated with them. The lack of easily wearing parts and the simplicity of the Spread Anchor Ring Clutch means that they will see many years use, with only basic care. All lifting components within the Spread Anchor system undergo specific testing procedures. In addition, all sizes of anchors are routinely batch tested. Every Spread Anchor Ring Clutch is individually tested and comes uniquely stamped with a corresponding lifting certificate.

There are six simple steps to utilise the Spread Anchor System:

1. Select the correct capacity and length of Spread Anchor.
2. Insert the Spread Anchor into corresponding Rubber Former, these are re-usable and with adequate cleaning and care should see many repeat uses. This should be fixed to the formwork with a Holding Plate or Holding Screw or suspended within the formwork.
3. Once the Spread Anchor is firmly in place, the concrete can be poured.
4. After sufficient concrete strength has been achieved, the Rubber Former can be removed from the concrete, revealing the head of the Spread Anchor with its safe working load indicated. The Rubber Former leaves the anchor below the concrete surface in a pocket of a size specific to the corresponding Spread Anchor Ring Clutch.
5. Engage the Spread Anchor Ring Clutch with the Spread Anchor and rotate the lever approximately 90 degrees until it lies flat on the concrete surface to indicate correct engagement.
6. Attach lifting chains and commence lifting, the universal joint of the Spread Anchor Ring Clutch will allow lifting at any angle. Simply reverse section 5 to disengage the Spread Anchor Ring Clutch.

Overview of the Spread Anchor System

The Spread Anchor system is supplied in a wide range of lifting capacities ranging from 0.7 tonnes to 22.0 tonnes. The method of use is the same throughout the size range. There are three basic components to the range:

1. Spread Anchor

The Spread Anchor is permanently cast into the concrete unit. It is manufactured from specially ductile steel making it safe to use at low temperatures. The safe working load of the anchors is based on a factor of 3 for safety.

2. Rubber Former

The Rubber Former is manufactured from flexible material and is semi-circular in shape. It is designed to open to allow the Spread Anchor to be inserted, once closed it provides an adequate seal to prevent concrete ingress. After the concrete has been poured and cured the Rubber Former is removed to reveal the Spread Anchor in its pocket. The Rubber Formers should be oiled after each use and can be used many times over.

3. Spread Anchor Ring Clutch

The Spread Anchor Ring Clutch is an all cast item specially designed not only to fit the Spread Anchor of its related safe working load but also to match the pocket created by the corresponding capacity Rubber Former. In this way, one can be assured that no two lifting capacities canbe utilised together, thus guaranteeing the safe working load is matched for all items utilised in the lifting process. The Spread Anchor Ring Clutches are individually tested and come uniquely stamped with a corresponding lifting test certificate. The safe working load of the Spread Anchor Ring Clutch is based on a factor of 3 for safety.

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Selecting the Correct Spread Anchor

Selection of the correct Spread Anchor is based upon two main factors. Firstly the safe working load of the Spread Anchor itself and its ability to carry the unit in question, under all relevant loading conditions at the time of lifting. These include, weight of the unit, demoulding forces, dynamic loading, the number of effective lifting points and increased tension in angled lifting slings. Secondly, the strength of the surrounding concrete and its ability to resist pull out forces induced upon it by the lifting system. This can be influenced by several factors, such as, the compressive strength of the concrete, the Spread Anchor length, edge distances, the distance between adjacent Spread Anchors and the ability of thin panels to resist compressive loads damaging the faces.

This manual will guide you through the necessary steps to determine both of these criteria. Firstly, the following should be noted. The normal minimum factor of safety for pull out is 2.5 and tables in this manual are based upon this.

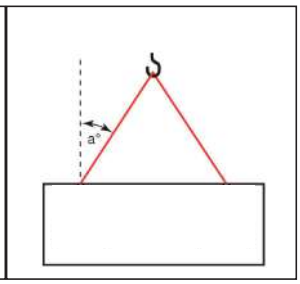
No lifting should take place below 15 N/mm² though certain other restrictions apply which will be covered later.

Angle of Lift

Any inclination of the sling angle from the vertical will have a direct result on the load induced on the Spread Anchor via the lifting slings. The following values in table 1 apply for this facto **Sa**.

table 1
Single Angle Load Factors

Angle from Vertical aº	Factor Sa
0	1.00
15	1.04
30	1.16
45	1.41
60	2.00



Removing the Unit from the Formwork

Considerable loads can be induced on the anchors whilst attempting to remove a concrete unit from the formwork (demoulding). This load is influenced greatly by the type of formwork material utilised and the surface area directly in contact with the concrete. The load values per square metre are given in table 2 for various formwork materials. This figure will give us the mould adhesion factor **Ma** and is calculated as follows:

Ma = (W+ (S x Al))/W

Where **W** is the static weight of the unit;
Where **S** is the surface area of formwork in contact with the unit in m^2;
Where **Al** is the load per m^2 for various formwork materials obtained from table 2.

table 2
Demoulding Factors

Formwork Materials	Load per m^2 Al (Kg)
Flat steel shutters	100
Flat plywood shutters	200
Flat sawn boards	300

For special shaped elements the following factors for **Ma** apply:

Double T Beams **Ma**=2.00
Coffered Slabs **Ma**=3.00

It is important to note that this factor only influences demoulding and plays no part in any general lifting operation and can therefore be ignored for general lifting purposes.

Speed of Hoist and Transport

Dynamic forces caused by the speed at which a unit is hoisted and the terrain it is transported over also affect the load induced on an anchor. The factor **V** for various rope speeds and terrain are given in table 3.

table 3
Rope Speed and Transport Factors

Lifting Conditions	Factor V
Static crane with rope speed below 90 metres/min	1.00
Static crane with rope speed above 90 metres/min	1.30
Lift and transport with mobile crane on smooth ground	1.75
Lift and transport with mobile crane on uneven ground	2.00
Lift and transport over rough ground	3.00

Note at demould stage the unit is static hence the lifting factor is effectively 1.

It must be noted that the means of lifting and transportation of units utilising the anchors can have a dramatic effect on the final load generated. With this in mind it must be stressed that great consideration must be taken whilst determining this factor. It is important not only to consider factory conditions but also the conditions the unit will be handled under, outside the production facility.

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Spread Anchor Load Rating

Firstly we must determine the Spread Anchor load rating. The capacity required is determined by the final load value on the anchor. This value is derived from a combination of loads and factors influencing the anchor during the lifting process.

These are as follows:

The static or dead weight of the actual concrete unit, this is load **W**.

The quantity and positioning of anchors with their sling arrangements. The numbers of effective anchors is divisible into the dead weight of the unit giving the static weight per anchor **z**.

The angle of lift (angle of sling or chains connecting to the anchor from the vertical), this is factor **Sa**.

Removing a unit from formwork increases the load on the anchor and is related to the surface area of formwork in contact with the concrete. This is the mould adhesion factor **Ma**.

The speed at which the unit is hoisted and ground conditions the unit is being transported over. This is the dynamic load factor **V**.

In order to accurately determine the correct size of anchor to be used all these loads and factors have to be combined. The following sections elaborate these factors further.

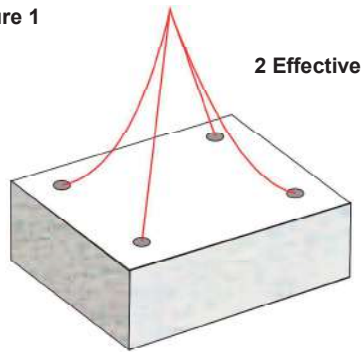
Static Weight

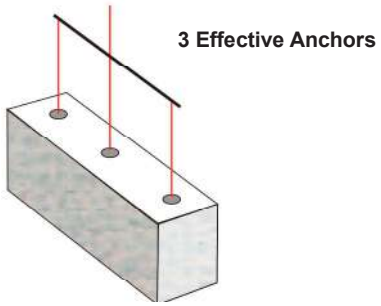
This is the actual mass of the concrete unit and for general purposes is determined from a density figure for reinforced concrete of 2.5 tonnes per cubic metre. The volume in cubic metres of the unit to be lifted, multiplied by the density figure of 2.5 tonnes/m³ will give us the static weight **W** in tonnes.

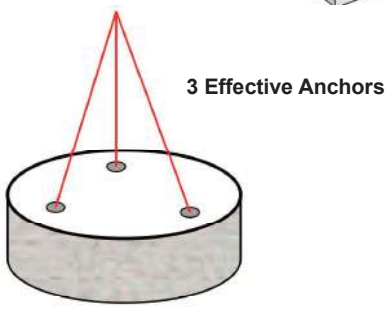
Number and Positioning of Anchors and Slings

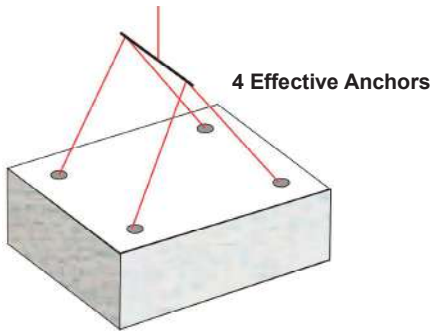
The weight carried by each anchor is directly affected by the number of anchors being used to carry the unit, and their orientation about the centre of gravity of the unit. It is important that the anchors are placed equidistant about the centre of gravity in any one axis. At this stage, it is also worth noting that the number of slings and type of sling system will also affect the load on the anchors. For this reason, unless there is some means of balancing the slings, we can only assume that if four slings are connected to four anchors in an un-balanced system, only two anchors effectively take the weight of the unit, therefore, half the weight of the unit is carried by each anchor. The actual static load per anchor **z** is the static weight of the unit divided by the number of effective anchors. Please see figure 1 giving the number of effective anchors for specific sling arrangements.

figure 1









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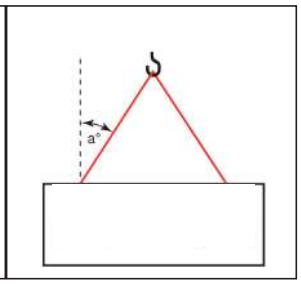

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Calculating the Load per Anchor

With all these conditions and factors in mind the load rating of the anchor can be calculated as follows:

Demoulding:

For demoulding we consider the dead weight per anchor **z**, the mould adhesion factor **Ma** and the increased load caused by the angle of lift **Sa**. The unit is effectively static at demould stage so dynamic loads need not be considered. The calculation is as follows:

Load per Anchor at Demould Stage (Fd)
Fd (tonnes) = z x Ma x Sa

General Lifting:

For general lifting we consider the dead weight per anchor **z**, the increase in load caused by the angle of lift **Sa** and the dynamic load factor **V**. The calculation is as follows:

Load per Anchor for General Lifting (Fl)
Fl (tonnes) = z x Sa x V

Where:

z is the dead weight of the concrete per anchor in tonnes.

Ma demould factor determined from:

Ma = (W + (S x Al))/W

Sa is the increased load factor due to sling angles.

V is the increased load factor due to rope speed and transport conditions.

With these loads calculated and if the same anchor is to be used for both demoulding and lifting the higher load value should be considered. This value if not an exact match to an available anchor range, should be rounded up to the next available. Where concrete dimensions allow, the longest corresponding Spread Anchor should be utilised.